FAA-E-2502
November 2, 1971
SUPERSEDES FAA-E-2352
2 July 1968

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION SPECIFICATION

AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS) TEST SET

1. SCOPE

1.1 Scope.- This specification covers a portable ATCRBS Test Set for maintaining equipments both at the transmitter site and the indicator site. The test set is housed in two separate cabinets; one cabinet contains the video test set functions and the other cabinet contains the rf test set functions. Indicator sites will use only the video test functions; whereas, transmitter sites will use both video and rf test functions.

2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The following FAA specifications and standards, of the issues specified in the invitation for bids or request for proposals, form a part of this specification.

2.1.1 FAA specifications.-

FAA-D-638	Instruction Books, Electronic Equipment
FAA-E-163b	Rack, Cabinet and Open Frame Types
FAA-E-2319B	Air Traffic Control Beacon Interrogator
FAA-G-2100/1	Electronic Equipment, General Requirements; Part 1, Basic Requirements for all Equipments

FAA-G-2100/2	Part 2, Requirements for Equipments Employing Electronic Tubes
FAA-G-2100/3	Part 3, Requirements for Equipments Employing Semi-conductor Devices
FAA-G-2100/4	Part 4, Requirements for Equipments Employing Printed Wiring Techniques
FAA-G-2100/5	Part 5, Requirements for Equipments Employing Microelectronic Devices

2.1.2 FAA standards.-

FAA-STD-013a	Quality Control Program Requirements
Agency Order 1010.51A	U. S. National Standard for IFF MARK X (SIF) Air Traffic Control Radar Beacon System Characteristics

(Copies of this specification and other applicable FAA specifications, standards, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration office issuing the invitation for bids or request for proposals. Requests should fully identify material desired, i.e., specification, standard, amendment and drawing numbers, and dates. Requests should cite the invitation for bids, request for proposals, or the contract involved or other use to be made of the requested material.)

2.2 Military documents.- The following military specifications and standards of the issues in the invitation for bids or request for proposals, form a part of this specification:

MIL-C-3098	Crystal Units, Quartz, General Specification for
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipments
MIL-STD-470	Maintainability Program Requirements (For Systems and Equipments)
MIL-HDBK-472	Maintainability Prediction
MIL-STD-756A	Reliability Prediction Procedures
MIL-STD-781B	Reliability Tests: Exponential Distribution
MIL-STD-785	Requirements for Reliability Program (For Systems and Equipments)
MIL-T-21038	(SHIPS) Transformer, Pulse

AD 821 640* RADC-TR-67-108 Reliability Stress and Failure Rate Data for Electronic Equipment

(Single copies of Military specifications may be requested by mail or telephone from U. S. Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Penna. 19120 (for telephone requests, call 215/697-3321, 8 a.m. to 4:30 p.m., Monday through Friday). Not more than five items may be ordered on a single request; the Invitation for Bid or Contract Number should be cited where applicable.)

*Copies of this document can be obtained from the National Technical Information Service (NTIS), Operations Division, Springfield, Virginia 22151.

2.3 GSA document.- The following General Services Administration document, of the issue in effect on the date of the invitation for bids or request for proposals, forms a part of this specification, and is applicable to the extent specified hereinafter: GSA Stock Catalog, Part III, Hand Tools

(Copies of the GSA Stock Catalog, Part III, Hand Tools, may be obtained from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., 20402; Price, 50 cents.)

3. REQUIREMENTS

3.1 Equipment to be furnished by the contractor.- Each indicator and transmitter site test set shall be in accordance with all specification requirements and shall include the major items specified in paragraph 3.1.1.

3.1.1 Test Equipments.- Requirements for two separate test equipments are specified herein. The indicator site test equipment shall be housed in a separate cabinet and contain all video test functions plus its own power supply. The transmitter site test equipment shall consist of the video test set plus an additional cabinet containing all rf test functions and its own power supply. The major deliverable items for each test site are as follows:

(a) Indicator Site

1. Video Test Set
2. Test Cart
3. Cables and Connectors
4. Special Tools
5. Instruction Books

(b) Transmitter Site

1. Video Test Set
2. RF Test Set
3. Test Cart
4. Cables and Connectors
5. Special Tools
6. Instruction Books

3.1.2 Instruction books.- Instruction books shall be furnished in accordance with FAA-D-638 and as specified in the contract schedule.

3.1.3 Frequency crystals.- Each Test Set shall be supplied with two complete sets of frequency crystals (one operating set and one spare set).

3.1.4 Special tools.- All hand tools which are necessary for field maintenance of the equipment shall be itemized in the instruction book. Those tools which are not listed in the GSA Stock Catalog, Part III, Hand Tools, card extenders and extractors shall be supplied by the contractor with each equipment.

3.2 Definitions.-

3.2.1 Pulse measurements.- The following definitions apply when making pulse measurements; reference is made to Drawing A-31054A, attached. These definitions supersede pulse definitions in FAA-G-2100/1, paragraphs 1-3.2.14 through 1-3.2.17.

3.2.1.1 Pulse amplitude.- The pulse amplitude is defined as the amplitude "A" of the equivalent rectangular pulse.

3.2.1.2 Pulse duration.- The pulse duration is defined as the duration "t" of the equivalent rectangular pulse and is the duration of the actual pulse between the 50 percent amplitude points on the leading and trailing edges.

3.2.1.3 Pulse rise time.- The pulse rise time is defined as that portion of the total rise time for the pulse to change from 10 percent to 90 percent amplitude.

3.2.1.4 Pulse decay time.- The pulse decay time is defined as that portion of the total decay time required for the pulse to change from 90 percent to 10 percent amplitude.

3.2.1.5 Pulse slope.- The pulse slope is defined as the difference between the amplitude of the pulse when its leading edge passes from a substantially linear slope to a substantially non-linear slope and its amplitude at the instant when the trailing edge of the pulse passes from a substantially non-linear slope to a substantially linear slope. Slope shall be expressed in terms of percent of pulse amplitude.

3.2.1.6 Pulse train droop.- Pulse train droop is defined as the ratio of the difference between the amplitude of the first and last pulse in a pulse train to the amplitude of first pulse in that train.

3.2.1.7 Pulse spacing.- Measurements of spacing between pulses and other time measurements made with a pulse as reference shall be made with reference to the instant the leading edge of each pulse reaches 50 percent (point "h", drawing A31054A, attached) of the pulse amplitude.

3.2.3 Interrogation modes.- The interrogation modes referred to herein are comprised of two pulses designated P_1 and P_3. The time P_3 is considered zero range time. The spacing of pulses (3.2.2.7) for each interrogation mode is as follows:

Mode	Spacing (microseconds)
1	3 ± 0.1
2	5 ± 0.1
3/A	8 ± 0.1
B	17 ± 0.1
C	21 ± 0.1
D	25 ± 0.1

3.2.4 Side lobe suppression pulse.- The Side Lobe Suppression (SLS) control pulse is designated P2. The pulse occurs 2.0 ± 0.1 microseconds after the first interrogation pulse P1, as specified in the U. S. National Standard.

3.2.5 Reply codes.- The reply codes contain two framing or bracket pulses, from zero to a maximum of 13 information pulses, and a special position identification (SPI) pulse spaced 4.35 ± 0.1 usec after the last framing pulse. The reply pulse train in response to a particular interrogation mode shall be synchronous with interrogations on that mode. The reply code characteristics are described in the U. S. National Standard for the MARK X (SIF) Air Traffic Control Radar Beacon System Characteristics. Reply codes specified herein are in accordance with the U. S. National Standard.

3.2.5.1 Reply code identification.- Reply codes are classified as common system discrete reply codes and nondiscrete reply codes.

3.2.5.1.1 Common system discrete reply codes.- Common system discrete reply codes use the framing pulses plus the A, B, C, and D pulse positions and the SPI pulse. This provides 4096 reply codes and the capability of adding the SPI pulse to each reply code. The discrete reply code number consists of four digits. Each digit may have a value of 0 through 7. The first (most significant) digit consists of the sum of the subscripts of the "A" pulse positions employed, the second digit consists of the sum of the subscripts of the "B" pulse positions employed, the third digit consists of the sum of the subscripts of the "C" pulse positions employed, and the fourth digit consists of the sum of the subscripts of the "D" pulse positions employed. Identification may be accomplished by transmission of the SPI pulse, 4.35 ± 0.1 microseconds after the second framing pulse, or by the repetition of the entire code train with the first framing pulse of the second pulse train following 4.35 ± 0.1 microseconds after the second framing pulse of the first train. Assignment of reply codes not employing any of the "C" and "D" pulse positions to a "nondiscrete" code category leaves 64 discrete reply codes for air traffic control aircraft identification.

3.2.5.1.2 Common system nondiscrete reply codes.- Common system nondiscrete reply code structure is the same as the discrete reply code structure except that the "C" and "D" pulse positions are not employed. This provides 64 four-digit codes, with the last two digits always zero.

3.2.6 Fruit.- The term "fruit" as used herein is defined as pulses at the beacon receiver output which are not in synchronism with the interrogation period.

3.2.7 Defruit.- "Defruit" is a term referring to a technique of interference suppression wherein a beacon reply is checked for synchronism with the beacon interrogation rate to allow rejection of asynchronous beacon replies (fruit).

3.2.8 Three-pulse side lobe suppression (SLS).- Three-pulse SLS is a technique for suppression of transponder replies to interrogations by the side lobe radiation of the directional antenna. The interrogation mode pulse pair, P_1 and P_3, are radiated by a rotating directional antenna and control pulse, P_2, is radiated by an omni-directional antenna. The P_2 pulse occurs at a specific time interval after the first interrogation pulse, P_1, and at a fixed amplitude ratio with P_1. The airborne radar beacon transponder contains circuitry for amplitude comparison and pulse spacing recognition of pulses P1 and P_2 and for suppression of replies to side lobe interrogations.

3.2.8.1 Improved side lobe suppression (Improved SLS).- The operation of Improved SLS is basically the same as three-pulse SLS, except that P_1 is transmitted from both the directional and omni-directional antennas instead of only the directional antenna. This enables suppression of transponder replies to reflected-path interrogations by providing a direct-path P_1 signal for time and amplitude comparison with P_2.

3.2.9 Unit.- The word "unit" as used herein denotes a completely assembled and wired panel assembly, chassis assembly, a combination chassis-panel assembly or an electromechanical assembly.

3.2.10 Ripple voltage.- Ripple voltage is referred to as the peak-to-peak value of a simple or complex waveform consisting of power line frequency components and harmonics thereof, and synchronous and repetitive non-synchronous transients.

3.3 General requirements.- The basis of overall test set design shall be the achievement of maximum operational reliability, availability and ease of servicing.

3.3.1 Solid state devices.- To ensure maximum reliability, the contractor shall design the circuitry of the test set around semi-conductor devices in accordance with FAA-G-2100/3 and microelectronic devices in accordance with FAA-G-2100/5.

3.3.2 Printed wiring and printed circuit boards.- Printed wiring and printed circuit boards shall be as specified in FAA-G-2100/4.

3.3.3 Service conditions.- The service conditions shall be those specified in FAA-G-2100/1, paragraph 1-3.2.23. The AC line voltage shall be 120 volts and the ambient conditions shall be those of Environment II.

3.3.4 Power source.- The test set shall operate from a single phase two-wire AC line power source. The design center value (1-3.2.21, FAA-G-2100/1) shall be 120V 60Hz.

3.3.5 Modular construction.- Plug-in solid-state modules shall be used to the maximum extent practicable.

3.3.6 Mounting.- The test set shall be mounted in an instrument cabinet (3.3.7) and shall include facilities for mounting in a Type 1 Cabinet Rack (FAA-E-163b) when removed from the instrument cabinet as specified in 3.3.6.1.

3.3.6.1 Chassis mounting in cabinet rack.- The chassis shall be approximately 18 inches in depth and shall be designed in such a way that it and its complete slide assemblies can be easily removed from its individual instrument cabinet and easily installed by its slide assemblies into a cabinet rack. Front panel screws shall secure the test set into the cabinet.

3.3.7 Instrument cabinet.- An instrument cabinet shall be provided for each test set. The overall depth of the combined cabinet and test set shall not exceed the overall depth of the Type 1 cabinet rack. The video test sets cabinet shall be stackable on the rf test set cabinet with provisions made to prevent the video test set from sliding off. In the stacked position, the withdrawal of one test set's chassis shall not mechanically interfere with the other test set. When all or any combination of the test sets are withdrawn from their cabinets, the cabinets shall not tip.

3.3.8 Front panels.- The front panels shall be in accordance with FAA-G-2100 (see applicable supplement). Panel size shall be selectable from panel sizes C, D or E. The panel size (height) can be different between the video test set and the rf test set.

3.3.9 Chassis construction.- Chassis construction shall be such that all components parts, test points and internal maintenance adjustments shall be available from the front, or right, or left side of the chassis. The chassis shall be the horizontal drawer type and shall be mounted to the instrument cabinet by non-friction (roller type) slides. Complete withdrawal of the chassis from its cabinet shall be possible. Mechanical means shall be provided to lock the chassis in place in its full withdrawn position. It shall also be possible to easily remove the chassis from its cabinet.

3.3.9.1 Cable connectors.- All cable connections to the test set chassis shall be through cable connectors to facilitate quick removal from the instrument cabinet.

3.3.10 Grounding of equipment.- Each unit of the test set, as well as the test cart, shall be grounded through the AC line cord and AC line cord jumpers, 3.3.14 when the equipment is connected to a grounded, wall type convenience outlet.

3.3.11 Unit protection.- Each completely assembled unit of the test set shall be so constructed that it can be removed from the instrument case and placed on a work bench for servicing, without damage to the units.

3.3.12 Panel protection.- Guard handles shall be provided on the front panel of the unit to protect the controls and indicators, as well as to aid in removing the unit from the instrument cabinet. The guard handles shall be of polished metal construction.

3.3.13 Test cart.- A cart shall be furnished to provide a mobile support for each test set. The cart shall have a one-inch metal tubular frame. The frame shall be mounted on five-inch, swivel, rubber-tipped casters with front wheel brakes. An open steel shelf, topped with tough easily-cleanable material, shall be located at the bottom just above the casters. An adjustable shelf to support the test set shall be located 31 inches from the floor. A drawer two inches deep and extending across the width and depth of the cart shall be located just below the top shelf. The drawer shall be felt lined and operate on roller bearings or bushings. The overall dimensions of the cart shall not exceed a height of 39 inches, a width of 26.5 inches, and a depth of 29 inches. Provision shall be made for operating the test set in nine positions. The adjustable shelf shall tilt-lock in each of six 4.5 degree steps in the upward direction and each of two 4.5 degree steps in the downward direction from the horizontal axis. It shall also lock in the horizontal position. Self-tapping, sheet metal, or machine steel screws may be employed where necessary. Painted areas shall be 25184 (blue) of FED-STD-595 or equivalent. Power input Hubbell 5240 or equivalent and three convenience outlets shall be provided in the rear of the cart. A cable shall be provided in accordance with 3.3.14 for connecting the power input outlet to a wall type convenience outlet. The convenience outlets provided on the scope cart shall be three-wire grounding type convenience outlets.

3.3.14 Transmitter site test set cables.- The following cables shall be provided:

a. RF cable type RG-58C/U with UG-88A/U connector on each end: two 5-foot cables and one 10-foot cable. The attenuation of the cable in hundredths of decibels shall be marked on each cable.

b. RF cable type RG-58C/U with UG-88A/U connector on each end: one length just sufficient to connect the RF oscillator output jack to the RF input jack of the demodulator.

c. Video cable type RG-59B/U with UG-260C/U connector on each end: four 5-foot cables and two 10-foot cables.

d. Video cable type RG-59B/U with UG-260C/U connector on each end: two cables just sufficient in length to connect the video output jack of the video test set unit to the input jack of the signal generator unit.

e. RF cable type RG-214/U with UG-59/U connector on each end; one 10-foot cable. The attenuation of the cable in hundredths of decibels shall be marked on the cable.

f. AC line cord, 8-foot length, with three-wire grounding plug, Hubbell type 5267 or equal, for connecting the test cart to a wall type three-wire grounding convenient outlet.

g. Two AC line cord jumpers with three-wire grounding plug, Hubbell type 5267 or equal, for connecting the equipment to a convenience outlet on the scope cart.

3.3.14.1 Indicator site test set cables.- Cables listed in 3.3.14 c, d, f and one cable in 3.3.14 g shall be provided.

3.3.15 Connectors.- All coaxial connectors unless otherwise specified shall be the BNC type and shall employ the captivated contact principle. External jacks for video signals shall be BNC type UG-262/U. External jacks for rf signals shall be BNC type UG-291/U. Adapters shall be provided for each test set in the following quantities:

Adapter	Quantity
UG-273/U	3
UG-309/U	2
UG-201/U	1
UG-306/U	2
UG-274B/U	2

The rf adapters will not be required for the video test set.

3.3.16 Power supplies.- A separate power supply shall be provided in each test set (video test set and rf test set). A switch located on the front panel of each test set shall turn the power on and off and a pilot light located on the front panel of each unit shall indicate when power is being applied to that unit.

3.3.16.1 Ripple voltage.- The peak-to-peak value of ripple voltages shall not exceed 0.1 percent of the d.c. power supply voltage for all electronically-regulated power supplies.

3.3.16.2 Power supply indicators.- Each circuit protected by a fuse or circuit breaker shall have an indicator lamp which shall be illuminated when the fuse or circuit breaker is open. Neon indicator lamps shall be used whenever possible. All indicator lights shall be uniformly located with respect to the associated fuses or circuit breakers, or they may be an integral part of the fuse holder assembly.

3.3.17 Reliability/maintainability.-

3.3.17.1 Reliability.- The test set shall have a "Minimum Acceptable Mean-Time-Between-Failure (θ_1)" of 1,000 hours, where θ_1 is defined by MIL-STD-781B. The reliability goal for the test set shall be 2,000 hours MTBF.

<u>3.3.17.1.2 Reliability program.</u>- A reliability program shall be performed in accordance with Section 5 (omit 5.2.4, 5.3.2 and 5.5.1) of Military Standard MIL-STD-785A modified as follows:

(a) Existing available failure data or predicted failure rates for all types of parts in the equipment design shall be used to calculate equipment reliability. The contractor shall not perform statistical failure tests for the purpose of establishing parts failure rates and qualifying parts for use in the equipment.

(b) For those nonstandard parts for which failure rate is not available the procedure of paragraph 5.2.3 of MIL-STD-785A shall be followed or a suitable alternate.

<u>3.3.17.1.3 Reliability Prediction.</u>- A design reliability prediction shall be made using the methods contained in paragraph 5.2, MIL-STD-756A and RADC-TR-G7-108, Reliability Stress and Failure Rate Data for Electronic Equipment. Revised predictions are required when design changes affecting equipment reliability are made.

<u>3.3.17.2 Maintainability.</u>- All electronic and mechanical equipment and parts shall be designed and fabricated to minimize the skill, experience, and time necessary to assemble and maintain them. Corrective maintenance shall use a remove-and-replace philosophy with actual repair to the replacement module to be accomplished later in a separate maintenance area.

<u>3.3.17.2.1 Maintainability program.</u>- A maintainability program shall be performed in accordance with Section 5 of MIL-STD-470.

<u>3.3.17.2.2 Maintainability prediction.</u>- A maintainability prediction shall be performed in accordance with procedure two of MIL-HDBK-472. The mean-time-to-repair (MTTR) shall not be more than 30 minutes.

<u>3.3.18 Radiation interference and susceptibility.</u>- The design and construction of circuits, shielding, and filtering shall be such as to meet the radiated and conducted emanations and the susceptibility requirements of MIL-STD-461 for Class 1C equipment. The tests performed shall be as listed in Table II of MIL-STD-461 for Class 1C equipment.

<u>3.4 Video test set.</u>- The video test set shall be designed to provide the following functional capabilities in accordance with the requirements of this specification:

(a)	Synchronization, internal-external	3.4.1
(b)	Crystal markers	3.4.1.1
(c)	Trigger generator	3.4.1.4
(d)	Interrogation mode trigger generator	3.4.2
(e)	Reply video code train generators	3.4.3
(f)	Noise generator	3.4.4

3.4.1 Synchronization.- The test set shall contain a crystal controlled oscillator as a calibrated timing source. The oscillator and related circuitry shall provide internal synchronization (3.4.1.2) and precisely timed crystal markers (3.4.1.1). The test set shall also be synchronized by external triggers (3.4.1.3). A front panel, two position, trigger select switch shall be provided for selecting internal or external triggers for test set synchronization. All features of the test set, except the internal PRF-period generator, crystal markers and noise generator (3.4.4) shall operate in synchronization with the external trigger when external synchronization is selected; the internal PRF-period generator shall remain in an operate condition, but its output will not be used until internal synchronization is selected. The crystal markers which are internally synchronized only and the noise generator output shall be available when selected regardless of internal/external synchronization position.

3.4.1.1 Crystal markers.- Crystal controlled time markers (0.100, 1.000, 1.450 and 10.000 microseconds) shall be provided at a front panel BNC connector for calibration purposes. These markers shall be individually selectable by a front panel crystal marker selector switch which shall have an OFF position. Amplitude of the crystal markers shall be continuously variable by means of a front panel control between 0.5 and 5.0 volts. Duration of the crystal markers shall not exceed 0.05 microseconds for the 0.100 markers, 0.2 microseconds for the 1.000 and 1.450 markers and 0.3 microseconds for the 10.000 markers.

3.4.1.2 Internal PRF-period generator.- The internal PRF-period generator shall be enabled and synchronized by the crystal controlled oscillator and related circuitry. The PRF-period generator shall generate a crystal controlled time period adjustable by front panel, indicator type, selector switches from 200 to 9,999 microseconds in 1.0 microsecond intervals. The output period accuracy and indication dial accuracy shall be 0.01 percent over the entire range, and the jitter shall be less than 0.040 microseconds for any period selected. Two plastic encapsulated conversion charts, converting time periods to PRF in increments of 25 pulses per second shall be provided with each test set. The PRF-period output shall be used for all internal timing of the test set when internal synchronization is selected.

3.4.1.3 External synchronization.- A front panel input BNC connector shall be provided for accepting external synchronization triggers. The trigger input circuit shall incorporate a 75 ohm terminating resistor that can be switched in or out of the input circuit by means of a front panel switch. With the 75 ohm resistor switched out, the impedance of the input circuit which shall be capacitive coupled shall be a minimum of 20,000 ohms.

3.4.1.3.1 External trigger.- External input trigger characteristics are:

a.	Pulse polarity:	Positive
b.	Pulse duration:	0.3 to 10 microseconds
c.	Pulse amplitude:	2.5 to 50.0 volts across 75 ohms terminating resistor
d.	Pulse PRF:	Any rate from 50 to 2,000 pulses per second inclusive
e.	Pulse rise time:	Less than 0.5 microsecond per volt

<u>3.4.1.4 Trigger generator.</u>- The trigger generator shall be enabled and synchronized by either the internal PRF-period generator (3.4.1.2) or by an external trigger (3.4.1.3) depending on the position of the internal/external synchronization switch (3.4.1). Two separate, electrically isolated, zero delay ("0") triggers shall be available at separate front panel BNC connectors. One electrically isolated delay trigger shall also be available at a separate front panel BNC connector. The delay shall be continuously variable in increments of 1.0 microsecond from 1.0 microsecond to 400 microseconds by means of front panel controls. The sensitivity and accuracy of the delay controls shall be such that any delay within the range specified can be set (using only the delay controls) to within 0.05 microseconds. Jitter of the delay trigger with respect to the "0" trigger shall not exceed 0.01 microseconds.

<u>3.4.1.4.1 "0" and delay trigger characteristics.</u>- Pulse characteristics of the "0" and delay triggers when driving 75 ohm terminating resistors shall be as follows:

a. Pulse polarity:	Positive
b. Pulse amplitude:	15 $\pm$ 2 volts
c. Pulse width:	1.0 $\pm$ 0.1 microseconds
d. Pulse rise time:	less than 0.15 microsecond
e. Pulse decay time:	less than 0.15 microsecond
f. "0" trigger jitter:	less than 0.01 microsecond

<u>3.4.2 Interrogation mode trigger generator.</u>- The interrogation mode trigger generator shall be internally enabled by either the "0" trigger or the delay trigger from the trigger generator. Selection of the desired trigger shall be by a front panel, two position, "0" - delay trigger select switch. The interrogation mode generator shall provide mode 1, 2, 3/A, B, C, and D interrogation triggers (see 3.2.3), the SLS pulse, P2, (see 3.2.4), mode interlace (see 3.4.2.2), mode designator triggers (3.4.2.2.2), and PRF staggering.

<u>3.4.2.1 Interrogation mode triggers.</u>- The interrogation mode triggers (consisting of P1 and P3 pulses) shall be available at a separate front panel BNC connector. A separate front panel switch shall be provided to allow switching the interrogation mode triggers in a non-additive manner to the composite video output, BNC connector (3.4.4). Pulse characteristics of the interrogation mode triggers when driving a 75 ohm terminating resistor and when driving the composite video circuitry are as follows:

a. Polarity	Positive
b. Amplitude	variable from 2.0 to 15 volts, minimum
c. Rise time	less than 0.1 microsecond
d. Decay time	less than 0.2 microsecond

<u>3.4.2.1.1 Interrogation mode trigger positioning and duration.</u>- By means of front panel controls, it shall be possible to select fixed or variable mode triggers with variable pulse widths for all modes selected. The mode triggers shall be capable of being changed in position, P1 with respect to P3, $\pm$ 1.5

microseconds from nominal P1 position. Pulse widths (P1 and P3) shall be variable from 0.2 to 1.5 microseconds. These controls shall be detented at nominal pulse position and pulse width.

3.4.2.1.2 SLS pulse (P2).- The P2 pulse shall be selectable by means of a front panel IN/OUT switch. When selected, the P2 pulse shall be available at the interrogation mode trigger connector (3.4.2.1) and also the composite video output connector when the interrogation mode triggers are switched to this connector (3.4.2.1). By means of a front panel control, the P2 pulse shall be variable in pulse position (P2 with respect to P1) $\pm$ 1.5 microseconds. P2 pulse width shall be variable from 0.2 to 1.5 microseconds and controlled by the P1 and P3 pulse width control, see 3.4.2.1.1. P2 pulse characteristics shall be as specified for interrogation mode triggers (see 3.4.2.1).

3.4.2.2 Mode selection.- The mode control circuitry shall provide individual mode selection capability by means of individual front panel switches. The front panel mode select switches shall enable mode designators X, Y and Z (see FAA-E-2319b specification) to be any one of modes 1, 2, 3/A, B, C and D.

3.4.2.2.1 Mode interlace.- The mode interlace circuitry by front panel selection shall provide for selected interlace of three interrogation modes, two interrogation modes, or operation on a single interrogation mode (no interlace). The following specific interlace patterns shall be attainable for three mode designators (X, Y, Z) by operation of a front panel switch(s):

(a) No interlace-continuous interrogation on X
(b) No interlace-continuous interrogation on Y
(c) No interlace-continuous interrogation on Z
(d) X, Y, X, Y, X, Y, etc.
(e) X, X, Y, X, X, Y, X, X, Y, etc.
(f) X, Y, Z, X, Y, Z, X, Y, Z, etc.
(g) X, Y, X, Z, X, Y, X, Z, etc.

3.4.2.2.2 Mode designator triggers.- The interrogation mode trigger generator shall provide individual front panel BNC connectors for mode designator triggers (X, Y and Z). Each mode designator trigger shall consist of a single pulse occurring at P3 time of its appropriate interrogation period. That is, the mode designator trigger shall be present only when its designated mode is generated. Mode designator trigger shall have the same pulse characteristics as specified for "0" and delay triggers (see 3.4.1.4.1).

3.4.2.3 PRF staggering.- PRF staggering circuitry identical to the PRF staggering circuitry in the beacon interrogator and in accordance with paragraph 3.4.2.7 of FAA-E-2319b shall be provided in the interrogation mode trigger generator. The PRF staggering shall be with respect to the "0" and delay triggers (3.4.2) and shall be enabled and disabled by means of a front panel switch.

3.4.3 Reply video code train generators.- The test set shall contain three independent code train generators. The code train outputs shall be non additive mixed and available as composite video signals at two separate, electrically isolated, front panel BNC connectors. By means of front panel controls, the composite video outputs shall be continuously variable between 0.5 and 15 volts when terminated in 75 ohm resistor. Pulse characteristics of the reply codes shall be as specified in paragraph 3.2.5, reply codes.

3.4.3.1 Triggering of reply code train generators.- By means of a front panel trigger select switch provided on each code train generator, it shall be possible to enable the reply code train generators with any of the following triggers:

(a) External trigger
(b) Mode designator trigger X
(c) Mode designator trigger Y
(d) Mode designator trigger Z

A front panel BNC connector shall be provided on each reply code train generator for accepting the external trigger whose characteristics shall be as specified in 3.4.1.3.1. It shall also be possible through the external connector to externally trigger the reply code train generator with noise from the noise generator (3.4.4.1). All other trigger inputs shall be internally switched. The trigger select switch on each code train generator shall have an OFF position.

3.4.3.1.1 Reply code train generator interlace.- The reply code train generators when being triggered with mode designator triggers shall interlace in accordance with 3.4.2.2.1.

3.4.3.2 Reply code train delay.- A variable delay shall be provided in each reply code train generator to delay the synchronizing trigger prior to code train generation. The delay shall cover a range from 1.0 to 3,000 microseconds and shall be continuously variable in increments of 1.0 microseconds over the entire range. The delay settings shall be performed by means of front panel indicator type controls only. The accuracy of the delay controls shall be such that any desired delay within the delay range can be set to within 0.50 microseconds. The maximum allowable jitter with respect to the initiating trigger shall be 0.03 microseconds or less over the entire delay range.

3.4.3.2.1 Reply code train delay trigger.- A delay trigger representing the delay selected shall be provided at a BNC connector located on the front panel of each reply code train generator. Pulse characteristics of this delay trigger shall be as specified for the "0" and delay triggers in 3.4.1.4.1 except jitter shall be as specified in 3.4.3.2.

3.4.3.3 Reply code train one.- In addition to the features discussed (see 3.4.3-3.4.3.2.1) reply code train one shall have the following functional capabilities (3.4.3.5):

(a) Code selection (A, B, C and D pulses)
(b) Selectable framing pulses
(c) X and SP IDENT pulse selection
(d) Code train pulse width adjust
(e) Code pulse substitution selection
(f) Code pulse substitution position adjust
(g) Emergency code simulations

3.4.3.4 Reply code trains two and three.- In addition to the features already discussed (3.4.3-3.4.3.2.1), reply code trains two and three shall have the following functional capabilities (3.4.3.5):

(a) Fine variable delay
(b) Code selection (A, B, C and D pulses)
(c) Fixed framing pulse
(d) X and SP IDENT pulse selection
(e) Code train pulse width adjust
(f) Code train pulse amplitude adjust

3.4.3.5 Reply code train functional capabilities.- All controls relating to the functional capabilities shall be located on the front panel of each reply code train generator.

3.4.3.5.1 Code selection.- Thumb wheel switches shall be provided to select any desired code combinations of A, B, C and D pulses as defined in paragraphs 3.2.5-3.2.5.1.2.

3.4.3.5.2 Fine variable delay.- Front panel fine delay controls capable of varying the delay in increments of 0.1 microseconds over a range of $\pm$ 3.0 microseconds from the selected code train position shall be provided. Accuracy of the delay controls shall be 0.01 microseconds or less.

3.4.3.5.3 Selectable framing pulses.- Framing pulses (see 3.2.5) shall be selectable by means of separate individual IN/OUT switches for F1 and F2. When the switches are in the IN position, the framing pulses shall be displayed along with the code pulses at the composite video outputs.

3.4.3.5.3.1 Fixed framing pulses.- When the selectable framing pulse feature is not required, fixed framing pulses shall be provided and displayed along with the code pulses at the composite video outputs.

3.4.3.5.4 X and SP IDENT pulse selection.- The X and SP IDENT pulses (see 3.2.5) shall be provided and shall be selectable by a four position switch having the following positions: OFF, X, SPI and X and SPI. The selected pulse(s) shall be displayed with the code train at the composite video outputs.

3.4.3.5.5 Code train pulse width adjust.- A pulse width adjust control shall be provided for adjusting pulse widths over a range of 0.15 to 1.00 microseconds. The control shall have detent positions for 0.35, 0.45 and 0.55 microseconds. The detent positions shall be accurate within 0.01 microseconds. This adjustment also applies to the X pulse and the framing pulses.

3.4.3.5.6 Code train pulse amplitude adjust.- A pulse amplitude adjust control shall be provided to vary pulse amplitudes of code trains between 0.5 and 15.0 volts prior to being mixed with the composite video output signals.

3.4.3.5.7 Code pulse substitution selection.- A code pulse substitution selector switch with the following positions shall be provided: OFF, F1, C1, A1, C2, A2, C4, A4, X, B1, D1, B2, D2, B4, D4, F2, F1-F2 and SPI. When any one of these pulse positions is selected, the substitute pulse shall replace the pulse normally appearing in that position.

3.4.3.5.8 Code pulse substitution position control.- A code pulse substitution position control shall be provided. This control shall vary the substitution pulse in 0.1 microsecond increments $\pm$ 1.5 microseconds from the nominal pulse position as defined in paragraph 3.2.5.

3.4.3.5.9 Emergency code simulation.- A separate four position switch shall be provided to simulate various emergencies. Position one of the switch shall be an OFF position. When in switch position two, the selected code shall be repeated four times for each PRF. When in switch position three, the selected code shall be repeated one time followed by three sets of framing pulses (no code pulses) for each PRF. In both switch positions two and three, the spacing between code trains shall be 4.35 $\pm$ 0.1 microseconds. When in switch position 4, any code selected (such as 7700, 7600 or 3100) shall be generated one time for each PRF.

3.4.3.5.9.1 Emergency code train burst control.- An emergency code train burst control circuit with required front panel controls shall be provided for controlling the number of emergencies generated. The type of emergency shall be determined by the emergency code simulation selector switch. It shall be possible to select any number of emergency code generations (one emergency code for each PRF) from one to 15 by means of a burst control selector switch which shall have an OFF position. When the selected number of emergency codes have been generated, the burst control circuitry shall stop emergency codes from being generated, and this non-generating state shall exist until the burst control circuitry is reactivated by means of a front panel reset switch; when reactivated, the cycle shall be repeated.

3.4.4 Noise generator.- A random noise generator selectable by a front panel ON/OFF switch shall be provided in the video test set. The generator shall generate 13 MHz random noise. A linear amplifier and associated front panel control shall be provided to vary the noise duty cycle up to 60 percent. The control indicator shall be accurate within 10 percent. The output noise amplitude shall be variable by a front panel control from 0.25 to 5.0 volts when driving a 75 ohm terminating resistor

3.4.4.1 Noise generator outputs.- The noise generator shall supply two separate isolated outputs. One output shall be provided through a separate front panel BNC connector; it shall be capable of externally triggering the reply code trains generators. The other noise output when selected by a front panel IN/OUT switch shall be applied through an isolation circuit and non-additive mixed with the signals at the composite mode video output (3.4.4). The noise shall be gated around the mode interrogation triggers appearing on the composite video output.

3.5 RF test set.- The RF test set shall consist primarily of a signal generator, a demodulator and a power supply.

3.5.1 Signal generator.- The signal generator shall generate selectable crystal controlled and variable RF frequency controlled outputs of constant amplitude of at least one milliwatt (0 dBM) across 50 ohms.

3.5.1.1 Front panel controls.- Front panel controls shall be provided to control all the operational requirements of the signal generator, and they shall be designed and arranged in a logical manner based on applied human engineering principles.

3.5.1.2 RF frequency outputs.- RF frequency outputs shall be as specified herein and selectable from any of the following three modes of operation:

(a) Continuous wave (CW)
(b) Sweep frequency (SWEEP)
(c) Pulse Modulation (PM)

All spurious and harmonic components of the RF outputs shall be at lease 60 db below the fundamental RF carrier.

3.5.1.3 Frequency generation.-

3.5.1.3.1 Crystal controlled frequencies.- Selectable crystal controlled frequencies, accurate to 0.005 percent or better, shall be generated at the following frequencies:

1. 1080 MHz
2. 1086 MHz
3. 1090 MHz
4. 1094 MHz
5. 1099 MHz

These frequencies shall be individually selectable by means of a front panel, common control and shall be capable of operating in the CW and PM modes as selected. PM shall only be applied at the specified RF carrier output frequency. Common multiplier and amplifier circuitry may be employed but random selection of any of the five specified frequencies (an OFF position shall also be provided on this control) shall not require tuning or adjustment of any type, and all RF peak carrier outputs (whether in the CW or PM mode) shall remain within 0.1 dB of each other as measured at the output for any fixed setting of the attenuator (3.5.1.4).

<u>3.5.1.3.2 Crystal outputs.</u>- As selected, the five crystal controlled frequencies (CW or PM) shall be applied to the Demodulator (3.5.2) and to the Attenuator (3.5.1.4) when in normal operation and only crystal controlled frequencies are being generated. When a variable RF frequency (SWEEP, CW or PM Mode) (3.5.1.2) is being generated as the output, selected crystal controlled frequencies shall only be applied to the demodulator and shall be at least 40 dB below the carrier level of the variable RF frequency at the output of the attenuator.

<u>3.5.1.3.3 Variable frequencies.</u>- A selectable variable frequency generator shall be incorporated, and it shall operate over a minimum frequency range of 1070 to 1110 MHz and shall be capable of operating in the CW, SWEEP, and PM modes as well as with an OFF position over the specified frequency range. The maximum frequency range shall not be greater than 1060 to 1120 MHz. At the contractor's option, the SWEEP generator may be separate from the generator utilized for the CW and PM modes of operation.

<u>3.5.1.3.3.1 Variable outputs.</u>- As selected, variable frequencies (CW, SWEEP, or PM) shall be applied to the Demodulator and to the Attenuator when in the normal operation and only variable frequencies are being generated. When a crystal controlled frequency (CW or PM mode) is being generated as the output, selected variable frequencies shall only be applied to the Deomodulator and shall be at least 40 dB below the carrier level of the selected crystal controlled frequency at the output of the Attenuator.

<u>3.5.1.3.4 Frequency control dial.</u>- The output frequency control dial shall be linearily calibrated in one MHz divisions as a minimum. The maximum deviation of the dial readings from theoretical linearity (degrees or distance) shall not exceed 20 percent total as measured with respect to the total dial travel. Initial calibration at ambient conditions shall provide for a calibration accuracy of better than 100 kHz at 1090 MHz and maximum dial calibration error over the service conditions shall be less than 1 MHz. Resettability shall be 250 kHz or better under all conditions.

<u>3.5.1.3.5 Frequency tuning and stability.</u>- With the output adjusted to any of the frequencies in the specified range and connected to an external precision digital electronic counter, the tuning mechanism and circuitry shall be so designed that a CW frequency setting within 10 kHz of any preselected frequency is a simple, smooth, straightforward procedure. Under these same conditions, with all controls remaining constant, the maximum plus and minus frequency variation from all causes shall not exceed 2 kHz as measured by the electronic counter; switching from CW to PM operation shall not cause the carrier frequency to change by more than 2 kHz.

<u>3.5.1.3.6 CW and PM power output stability.</u>- The peak carrier output power shall remain within 0.1 dB when switching between CW and PM modes of operation. PM shall only be applied at the actural RF carrier output frequency.

After initially adjusting the RF output level, the CW output shall remain constant within $\pm$ 0.1 dB as the RF frequency is tuned through the specified frequency range.

3.5.1.3.7 Sweep output.- When the SWEEP output is selected, the RF sweep output shall automatically cover the total specified minimum frequency range (1070 to 1110 MHz) and shall operate at a sweep rate of 100 Hz $\pm$ 5%. The RF sweep generator shall operate with a linear time/frequency change relationship and the maximum departure from linearity shall not exceed 5%. The sweep rf frequency peak carrier output shall be of constant amplitude, $\pm$ 0.1 dB.

3.5.1.3.7.1 Oscilloscope sync.- A video sawtooth type waveform, time/frequency synchronous with the RF sweep generator, shall be available at a front panel BNC jack, source impedance 75 ohms, to provide sync or horizontal drive to an external oscilloscope. This waveform shall accurately follow (maximum error 5%) the linear time/frequency change of the RF sweep generator output. This waveform shall be positive going with the lower voltage associated with the lower RF frequencies and the higher voltage associated with the higher RF frequencies. During retrace, higher frequency to lower frequency, the sweep RF output shall be OFF and the video output waveform, upon retrace, shall be clamped to assure that each repetitive waveform starts from the same reference voltage, at or near ground, for all operating conditions.

3.5.1.3.7.1.1 Front panel sync control.- A front panel sync control shall be provided to continuously adjust the peak amplitude of this sawtooth waveform over a 5 to 25 volt range with a peak variation not to exceed 10 percent over the service conditions.

3.5.1.4 Output attenuator.- The output attenuator shall terminate at a front panel mounted 50 ohms BNC output jack (RF OUTPUT). The output attenuator shall be mounted on the front panel and shall have a characteristic impedance of 50 ohms. The output attenuator shall be variable and shall be calibrated in 1.0 dB divisions from 0 to -100 dB below a milliwatt. When the output is terminated in 50 ohms, the maximum calibration error to the attenuator at the worse case calibration error point shall not exceed 1.0 dB; at 0 dBm the calibration error shall not exceed 0.1 dBm. The output attenuator shall not produce a standing wave ratio greater than 2.0 decibels when terminated in 50 ohms.

3.5.1.4.1 Calibration circuit.- An RF calibration indicator circuit shall be provided that has a 0 dBm meter. This circuit shall provide a means for setting the RF input to the attenuator to an accurate 0 dBm reference level.

3.5.1.5 Modulation.- The signal generator shall be capable of being satisfactorily pulse modulated (PM) with any combination of pulses and pulse trains as specified in the video test set portion (3.4) of this specification. A selectable front panel mounted BNC jack (EXT MOD) terminating the input in 75 ohms shall be provided for external PM input.

3.5.1.5.1 RF output pulse characteristics.- When externally modulated by pulses and pulse trains from the video test set (3.4) the PM RF output signal shall have the following characteristics:

a. Risetime 0.05 - 0.1 usec
b. Decay time 0.05 - 0.2 usec
c. Pulse train amplitude variations shall be less than 2% of the average maximum amplitudes.
d. The change in pulse width (modulation input versus RF output) shall be less than ± 25 nanoseconds.
e. The change in reply code pulse spacing (due to changes of pulse width) shall be less than 0.05 usec with any 2 pulses as reference.
f. The delay between the modulating pulse inputs and the RF outputs shall not be greater than 0.3 usec.

Input pulses of 25 volts amplitude shall not damage the test set.

3.5.2 Demodulator.- The demodulator shall be configured to provide detection and monitoring of all internally generated RF signals (minimum of two simultaneously) when operating in the CW, SWEEP, or PM configuration. The demodulator's operation shall be independent of and not affected by the Output Attenuator adjustments throughout the specified range of 0 to -100 dBm, and all internally generated RF signals shall automatically be adjusted for optimum mixing and detection requirements.

3.5.2.1 Demodulation of external signals.- The demodulator shall be configured to detect and monitor (on a continuous basis) external CW, SWEEP and PM RF signals when appropriately applied to one of four front panel connectors covering the following power ranges:

(a) 1 milliwatt RMS or less, use BNC connector
(b) 0 to 35 watts peak, use BNC connector
(c) 35 to 350 watts peak, use BNC connector
(d) 350 to 3500 watts peak, use HN connector

The input circuitry shall present a terminating impedance of 50 ± 5% ohms to the external input signal and shall not produce a standing wave ratio greater than two decibels.

3.5.2.2 Peak power measurements of demodulated signals.- The demodulation circuitry for items (b), (c) and (d) in paragraph 3.5.2.1 shall be designed in such a manner that the pulse amplitude of the demodulated signals shall indicate within 1.0 dB over all ranges the peak power of the demodulated RF signal. The back side of the plastic encapsulated conversion chart (time-periods to PRF) referenced in 3.4.1.2 shall contain a conversion chart converting pulse amplitude to peak power over all three ranges.

3.5.2.3 Demodulator frequency response.- The demodulator shall provide a flat detector response (within plus or minus 0.1 dB) over an RF frequency range of at least 1020 to 1110 MHz and no spurious responses shall be detected when utilized as specified herein.

3.5.2.4 Demodulation output characteristics.- The demodulator shall accurately detect and reproduce the pulse envelope of an applied RF pulse 0.2 to 1.5 microseconds in width and the maximum deterioration of pulse rise time and decay time shall not exceed 1.0 nanosecond and the induced ringing or overshoot shall not exceed 1%. The video response from detecting element to the output BNC jack shall be DC coupled. The demodulator shall also incorporate the necessary circuitry to provide a detected wideband video output peak voltage level of 0.1 volt as a minimum across 75 ohms at an output BNC jack for any input level specified (1 milliwatt RMS and above). The detected video output shall be in accordance with 3.5.2.2. A short across the output shall not cause any damage or failure to the demodulation circuits.

3.5.2.4.1 Monitoring demodulated wideband outputs.- When monitoring the demodulated wideband output it shall be possible to adjust the internal variable rf frequency generator to within 10 kHz of any internal selected crystal controlled frequency; selectable narrow banding to change the normal wideband output characteristics shall be provided to assure meeting this requirement without reference to any external frequency standards or measuring equipment.

3.5.2.4.2 Demodulator sweep output.- When SWEEP output is selected as the output and crystal controlled frequencies are also being applied to the demodulator, a marker pulse shall be generated at the demodulator output as the SWEEP frequency sweeps through the crystal controlled frequency. The duration of the marker shall be restricted to a $\pm$ 50 kHz bandwidth difference between the two rf carrier frequencies, and the peak amplitude shall be variable through a 0 to 10 volt range.

4. QUALITY ASSURANCE PROVISIONS

4.1 General requirements for inspection and tests.- See Section 1-4 of FAA-G-2100/1.

4.2 Required tests.- The contractor shall submit for approval, along with the proposed test methods and forms under 1-4.2 of FAA-G-2100/1, three copies of a comprehensive test plan including a list of tests to be performed under each class of tests specified in 1-4.3 of FAA-G-2100/1. The Government reserves the right to require any additional tests necessary to assure that all of the specification requirements are checked.

4.2.1 Reliability demonstration.- As a part of the Design Qualification Tests, the contractor shall perform a reliability demonstration of the test set in accordance with paragraph 4.2 of MIL-STD-781B and the requirements of this specification. The reliability demonstration shall be performed in accordance with Test Level A-1, Test Plan V of MIL-STD-781B. The contractor shall be allowed to ship equipments prior to completion of this demonstration; however, in case of equipment(s) failure to meet the requirements specified herein, the contractor shall incur ALL expenses required to make the delivered equipment acceptable.

4.2.1.1 Reliability demonstration test plan.- The contractor shall submit for approval to the Government's contracting officer a reliability demonstration test plan which conforms to the requirements of paragraph 4.2.1 herein. The reliability test plan shall be submitted sixty (60) days prior to start of test and shall be approved prior to conducting the test.

4.2.2 Maintainability demonstration.- As a part of the design Qualification Tests the contractor shall perform a maintainability demonstration in accordance with Method 3 of MIL-STD-471 and the requirements of this specification.

4.2.3 Enviromental testing.- The Design Qualification Tests shall include an environmental test in accordance with 1-4.12 of FAA-G-2100/1. The enviromental test shall demonstrate compliance to the performance requirements specified herein when operating over the range of service conditions specified in 3.3.3.

4.2.4 Twenty-four hour burn-in test.- All production equipments shall undergo a twenty-four hour burn-in test at the completion of production testing. After a 10 minute warm up period the equipment shall be adjusted and aligned for optimum performance and test measurements taken and recorded to verify all features are functioning properly. The equipment shall then operate for 24 hours during which time only front panel controls may be manipulated. At the end of the 24 hour operating period, the test measurements shall be repeated and recorded. All observations of malfunctioning or instability in the equipment shall be recorded on test data sheets and will serve as a log or history of the test. The Government representative/s shall be permitted to make any number of entries in the combined Government-contractor log even if not concurred with by representatives of the contractor. The equipment shall not be de-energized more than one time during the 24 hour time period and the total outage shall not exceed thirty minutes; if either of these are exceeded, the 24 hour burn-in test shall be repeated. All specification requirements specified herein shall be met during this test.

4.3 Quality control program.- The contractor shall prepare and maintain a quality control program which fulfills the requirements of FAA-STD-013a. Three copies of the quality control program shall be submitted to the Government for approval. The contractor's quality control program shall be a scheduled and disciplined plan of events integrating all necessary inspections and tests required to substantiate product quality during design, development, purchasing, subcontracting, shipping; and, where required by the contract, site installation. The contractor shall perform or have performed the inspections and tests required to substantiate product configuration and conformance to drawings, specifications and contract requirements and shall also perform or have performed all inspections and tests otherwise required by the contract. The contractor shall provide and maintain gages and other measuring and testing devices necessary to assure that materials, equipments, and systems conform to the technical requirements. In order to assure continued accuracy, these devices shall be calibrated at established intervals against certified standards which have known valid relationships to national standards. If production tooling, such as jigs, fixtures, templates, and patterns is used as a media of inspection, such devices shall also be provided for accuracy at established intervals. When required, the contractor's measuring and testing equipment shall be made available for use by the FAA Inspector to determine conformance of product with contract requirements. In addition, if conditions warrant, contractor's personnel shall be made available for operation of such devices and for verification of their accuracy and condition.

5. PREPARATION FOR DELIVERY

5.1 General packing requirements.- See FAA-G-2100/1b, paragraph 1-5.1.

5.2 Shipping instructions.- The Government will supply shipping information upon request from the contractor at the time the equipment is ready for shipment.

Attachment: Drawing A-31054A

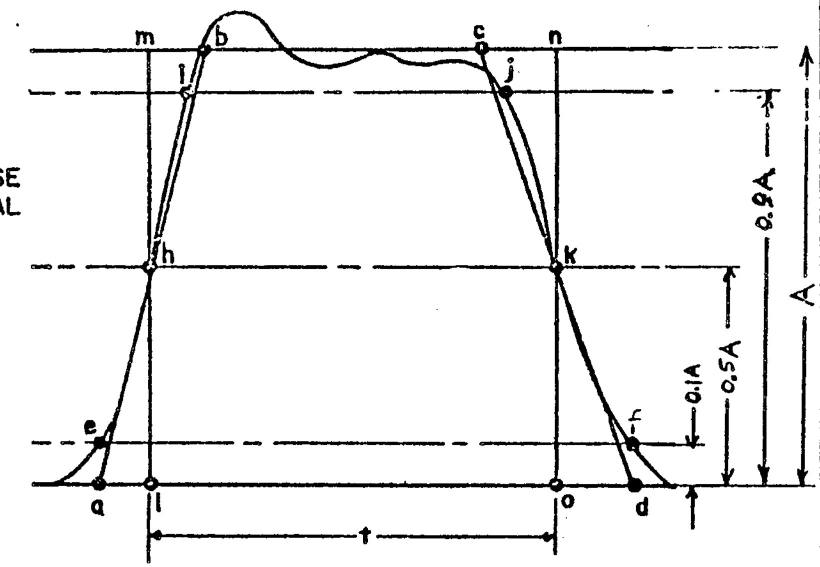
CONSTRUCTION OF EQUIVALENT RECTANGULAR AND TRAPEZOIDAL PULSE SHAPES

1. BY SUCCESSIVE APPROXIMATION OBTAIN RECTANGULAR PULSE (AMPLITUDE A) OF AREA EQUAL TO AREA UNDER ACTUAL PULSE AND PASSING THROUGH THE 0.5A POINTS (h.k.) ON THE ACTUAL PULSE ENVELOPE. THIS IS RECTANGLE l m n o.

2. CHOOSE POINTS e f AND i j ON THE ACTUAL PULSE AT 0.1A AND 0.9A LEVELS RESPECTIVELY.

3. THROUGH h DRAW a h b PARALLEL TO A STRAIGHT LINE CONNECTING e AND i.
   THROUGH k DRAW d k c PARALLEL TO A STRAIGHT LINE CONNECTING f AND j.
   THEN EQUIVALENT TRAPEZOIDAL PULSE a b c d.

NOTE: AREA a b c d = AREA OF RECTANGLE.
= AREA OF PULSE.



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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20590

REVIEWED BY

PULSE SHAPE PARAMETERS

SUBMITTED BY [signature]
ELECTRONIC STANDARDS SECTION

APPROVED BY [signature]
CHIEF, SYSTEMS STANDARDS BRANCH

DESIGNED BY T.D.
DRAWN BY J.L.S.
CHECKED BY K.A.J.

ISSUED BY
SYSTEMS RESEARCH AND DEVELOPMENT SERVICE
ENVIRONMENTAL DEVELOPMENT DIVISION

DATE 2/6/58
DRAWING NO. A-31054
REV. LTR A